Bonneville Power Administration
Fish and Wildlife Program FY99 Proposal Form

Section 1. General administrative information

Analyze the Persistence and Spatial Dynamics of Snake River Chinook Salmon

Bonneville project number, if an ongoing project 9064

Business name of agency, institution or organization requesting funding
U.S. Forest Service, Rocky Mountain Research Station

Business acronym (if appropriate) RMRS

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Subcontractors.

Organization	Mailing Address	City, ST Zip	Contact Name
N/A			

NPPC Program Measure Number(s) which this project addresses.

2.1A, 4.2A, 4.3C, 7.13C, 7.14C, 7.1E,

NMFS Biological Opinion Number(s) which this project addresses.

1.) NMFS consultations with the Boise National Forest require an assessment of the location of chinook salmon redds and spawning fish.

Other planning document references.

1.) The Draft NMFS Snake River Salmon Recovery Plan proposes an analysis of the spatial structure of wild chinook salmon populations.

2.) Monitoring adult chinook salmon spawning escapements is listed as a Critical Data Need by IDFG (1996).

Subbasin.

Upper Middle Fork Salmon River, Lower Middle Fork Salmon River

Short description.

Emerging conservation theory suggests that recolonization and persistence of widely ranging species may be strongly influenced by the spatial geometry of remaining habitats. The relevance of these concepts to the persistence of declining stocks of chinook salmon is unknown. If patterns in the distribution and spatial structure of chinook salmon populations are important to their persistence in stochastic environments, effective conservation may imply maintaining or restoring a critical amount or mosaic of habitat as well as smaller scale habitat characteristics. We propose new research to describe factors influencing the spatial distribution and persistence of wild chinook salmon. As our central hypothesis, we propose that habitat area, quality, or context (location in relation to other spawning populations) strongly influences the occurrence of spawning chinook salmon. We propose to test this hypothesis by describing the distribution of chinook salmon redds and spawning habitats within the Middle Fork Salmon River drainage. This research will advance current understanding of the relationship between landscape characteristics and the distribution, pattern, and persistence of chinook salmon. Such information could be key for development of conservation and restoration strategies.

Section 2. Key words

Mark	Programmatic Categories	Mark	Activities	Mark	Project Types
X	Anadromous fish		Construction		Watershed
	Resident fish		O & M	*	Biodiversity/genetics
	Wildlife		Production	X	Population dynamics
	Oceans/estuaries	X	Research	*	Ecosystems
	Climate		Monitoring/eval.		Flow/survival
	Other		Resource mgmt		Fish disease
			Planning/admin.		Supplementation
			Enforcement		Wildlife habitat enhancement/restoration
			Acquisitions		

Other keywords.

Spatial dynamics, persistence, extinction, recolonization, landscape associations

Section 3. Relationships to other Bonneville projects

Project #	Project title/description	Nature of relationship
8909800	Idaho Supplementation Studies	Collaborative, information sharing
9107300	Idaho Natural Production Monitoring/Evaluations (ESA)	Collaborative, information sharing
LSRCP Reimbursable Prgm.	Lower Snake River Compensation Plan Hatchery Monitoring and Evaluation (Nez Perce Tribe)	Collaborative, information sharing

Section 4. Objectives, tasks and schedules

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Map the distribution of chinook salmon redds	a	Count redds annually via aerial and ground-based surveys
		b	Use GPS to locate redds
2	Map the distribution of potential spawning patches	a	Aerially surveys spawning areas
		b	Validate aerial surveys with ground-based surveys
		c	Use GPS to locate spawning areas
3	Describe spawning patch quality	a	Measure indices of patch quality
4	Relate the location and quality of spawning patches to basin geomorphic features	a	Compile existing databases that describe basin landscape features (geology, elevation, aspect, etc.)
		b	Explore various regression and discriminate function analyses approaches
		c	Select the analysis and complete
5	Evaluate the influence of patch size, quality, and context on redd distribution	a	Explore various regression and discriminate function analyses approaches
		b	Select the analysis and complete

Objective schedules and costs

Objective #	Start Date mm/yyyy	End Date mm/yyyy	Cost %
1	09/1999	12/1999	35
2	07/1999	12/1999	35
3	07/1999	12/1999	5
4	12/1999	12/2003	10
5	12/2000	12/2003	15

Schedule constraints.

If water conditions limit the accuracy of redd counts, additional years of research may be required

Completion date.
2003

Section 5. Budget

FY99 budget by line item

Item	Note	FY99
Personnel	Four temporary field Technicians, one week of Helicopter Manager=s salary, five months of permanent Scientist salary	37,400
Fringe benefits	20.55%	7,690
Supplies, materials, non-expendable property	Equipment for aerial and ground-based surveys, this will be reduced after year 1	6,000
Operations & maintenance	Helicopter rental for aerial surveys, fixed-wing aircraft rental for access during ground-based surveys, vehicle costs	29,500
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		N/A
PIT tags	# of tags:	N/A
Travel		5,500
Indirect costs	18%	15,500
Subcontracts		N/A
Other		N/A
TOTAL		$101,600

Outyear costs

Outyear costs	FY2000	FY01	FY02	FY03
Total budget	103,700	105,800	108,000	110,400

O&M as % of total	30%	30%	30%	30%

Section 6. Abstract

We propose new research to describe factors influencing the spatial distribution and persistence of wild chinook salmon. Emerging conservation theory suggests that recolonization and persistence of widely ranging species may be strongly influenced by the spatial geometry of remaining habitats. As our central hypothesis, we propose that habitat area, quality, or context (location in relation to other spawning populations) strongly influences the occurrence of spawning chinook salmon. We propose to test this hypothesis by describing the distribution of chinook salmon redds and spawning habitats within the Middle Fork Salmon River drainage. A global positioning system (GPS) will be used to spatially locate redds and spawning patches that will be mapped using a geographic information system (GIS). Tests will be applied to determine the most appropriate spatial statistical analyses. If spatial concepts are important to persistence of declining chinook salmon stocks, the distribution of redds within suitable spawning habitats should significantly deviate from a random distribution. The 1994 Columbia River Basin Fish and wildlife Program calls for the acquisition of long-term monitoring, indexing, and life history information for Snake River chinook salmon. While this research will focus on larger scale spatial questions about persistence, it will simultaneously provide information useful for intensively monitoring an ESA listed chinook salmon stock. Our annual estimates of the total number of wild chinook salmon redds will enable managers to estimate annual adult escapement in order to monitor stock status and evaluate the influences of various mitigation and restoration efforts. Three years of data have already been gathered. The project will require a total of 5 years to follow one generation of spawning fish in order to complete the analysis of spatial structure.

Section 7. Project description

a. Technical and/or scientific background.

Chinook salmon Oncorhynchus tshawytscha stocks in the Snake River were listed as threatened under the Endangered Species Act in 1992. As a result of continued declines in abundance, their status was upgraded to endangered in 1994. The emergency classification to endangered terminated in 1995 and although the species status has not improved, they are again listed as threatened. The distribution and abundance of chinook salmon has declined from historical levels as a result of loss of access to historic habitat, passage mortality at dams and obstructions, habitat degradation, overharvest, and interactions with hatchery-reared and exotic fishes. An estimated 12,452 km of habitat are no longer accessible to anadromous fish in the Snake and Columbia river basins (NWPPC 1986). Construction and operation of mainstem Columbia and Snake river dams is considered the major cause of recent declines in anadromous fish (CBFWA 1991).

Nehlsen at al. (1991) identified habitat loss or degradation as a major problem for 90% of the 195 at risk salmon and steelhead stocks they identified.
The Council=s Fish and Wildlife Program (NWPPC 1994), the Salmon Subbasin Plan, and IDFG (1996) all call for long-term monitoring, indexing, and acquisition of life history information for chinook salmon. The Draft NMFS Snake River Salmon Recovery Plan calls for an analysis of the spatial structure of wild chinook salmon populations. Agencies have adopted policies in attempts to protect and restore remaining chinook salmon populations. These policies may include measures to maintain genetic integrity of remaining wild stocks; measures to reduce mortality by improving passage, reducing the effects of exotics, and restricting harvest; and measures to maintain remaining critical habitat (IDFG 1992). Maintaining critical habitat typically includes preventing further habitat degradation and restoring degraded habitats. There is growing concern that critical habitat should include landscape characteristics such as habitat size and spacing (Krohn 1992) in addition to smaller scale characteristics such as stream channel features. Effective conservation may imply maintaining or restoring a critical amount or mosaic of habitat as well (Simberloff 1988).

Recent papers suggest that conservation of declining salmonid stocks may require spatial concepts (Frissell et al. 1993; Rieman and McIntyre 1993). In one of the few studies examining the influence of larger scale processes on salmonid occurrence, Rieman and McIntyre (1995) reported that habitat area influenced the distribution of disjunct populations of bull trout. The authors suggested that larger-scale spatial processes may be important to salmonid persistence. The relevance of these concepts to declining populations of chinook salmon is unknown. existing literature is not sufficient to determine the relevance of larger-scale processes to persistence of salmonid populations. Theory suggests large scale spatial concepts may be important to persistence (Simberloff 1988, Krohn 1992, Frissell et al. 1993) but there is little empirical evidence (see Rieman and McIntyre 1995).

We propose to test these concepts by studying declining populations of chinook salmon in the Middle Fork Salmon River drainage. The study area is important for three reasons: 1) remaining wild chinook salmon have not been influenced by non-indigenous hatchery stocks which could confound a spatial analysis; 2) most of the drainage has been relatively lightly disturbed by anthropogenic activities so habitat quality has not been substantially altered in most areas; and 3) the large area contains multiple watersheds that provide the opportunity to obtain a sufficient sample size for testing hypotheses.

b. Proposal objectives.

Objective 1: Map the annual distribution of chinook salmon redds in the study area. Our hypothesis is that redds will not be randomly distributed. Our assumption is trained observers will be capable of distinguishing redds and that annual water conditions will be suitable for a complete inventory of all redds in the drainage.

Product: A complete annual count and database of spatially located chinook salmon redds in the study area.

Objective 2: Map the distribution of potential chinook salmon spawning areas (patches of suitable habitat) in the study area. Our hypothesis is that spawning patches will not be randomly distributed. Our assumptions are that we will be able to develop criteria for accurately defining potential spawning patches and that annual water conditions will be suitable for a complete inventory of all patches in the drainage.

Product: A database of spatially located potential chinook salmon spawning patches in the study area.

Objective 3: Describe spawning patch quality. Our hypothesis is that patch quality will vary within and across drainages. Our assumption is that we will be able to develop criteria for accurately assessing patch quality.

Product: A database of spatially located potential chinook salmon spawning patches in the study area linked to characteristics of patch quality.

Objective 4: Relate the location, size, and quality of spawning patches to basin geomorphic features. Our hypothesis is that large-scale geomorphic features influence the location, size, and quality of spawning patches in a predictable manner. Our assumption are that a database of geomorphic features is available for the study area and that a sufficient sample size of patches will be obtained to develop a robust model.

Product: A model that applies geomorphic features to predict the likelihood of a spawning patches location, size, and quality.

Objective 5: Evaluate the influence of patch size, quality, and context on the distribution of chinook salmon redds. Our hypothesis is that patch area, quality, or context influences the occurrence of spawning chinook salmon. Our assumption is that we will develop a large enough sample of spawning patches and redds to adequately test this hypothesis.

Product: A model that applies patch information to predict the likelihood of chinook salmon spawning. The model will incorporate a temporal scale to evaluate changes as the spawning populations expand or contract.

c. Rationale and significance to Regional Programs.

The Fish and Wildlife Program (NWPPC 1994) asks for Aimmediate efforts to gather data on wild and naturally occurring spawning stocks...≅. The Fish and Wildlife Program, IDFG (1992), and Salmon River Subbasin Plan all call for long-term monitoring, indexing, and life history information for wild stocks. This project addresses those stated needs. The research also shares and relies on information collected by the Nez Perce Tribe, Shoshone-Bannock Tribe, IDFG, and U.S. Forest Service. Results of the research are of critical importance to biologists and managers from these and other agencies including the NMFS. At a broad scale, emerging strategies to conserve and restore critical habitats and viable populations will be based on this and associated research.

d. Project history

Progress to Date: In 1995, we developed a draft study plan and coordinated with the Idaho Department of Fish and Game and U.S. Forest Service biologists. We developed a Memorandum of Understanding- No.INT-95121-MOU (attached) to coordinate our research with State of Idaho biologists and fisheries managers. We developed a cost-share agreement with the Payette National Forest to assist funding of a portion of the field work. In September, we flew reaches of the mainstem Middle Fork Salmon River and 12 tributaries and used a GPS unit to map the location of potential spawning areas and redds. We completed ground-based counts in four stream reaches that were not visible from the air. In September 1996 and 1997, we surveyed the same 12 tributaries and reaches of the mainstem, mapped chinook salmon redds, and mapped the location of potential spawning patches. Also in 1996 and 1997, we completed ground-based surveys of spawning patches in order to validate aerial survey data. GPS files have been corrected and transferred into GIS for spatial analysis. Summaries of 1995 and 1996 surveys have been submitted to collaborators listed above and other interested parties. Summaries of 1997 surveys are in progress.

e. Methods.

Objective 1: Because chinook salmon have specific spawning area requirements, not all areas of the Middle Fork Salmon River (MFSR) have the potential to support spawning fish. We selected potential study areas by reviewing past redd survey records, reviewing anecdotal accounts of redds and spawners, personal communications with biologists familiar with the drainage, and by reviewing records of juvenile chinook salmon occurrence. Existing information suggests a total of 12 tributaries and the mainstem MFSR have the potential to support populations of chinook salmon. Chinook salmon redd counts were made in Idaho as early as 1947, however, counts prior to 1957 were not consistently done (Hassemer 1993). Redd counts in 1953 documented chinook salmon spawning in the mainstem MFSR and the Bear Valley, Big, Camas, Indian, Loon, Marble, Marsh, Rapid River, and Sulphur creek drainages (Hauck 1954). Gebhards (1959) reviewed historical information and reported chinook salmon spawning in the Pistol and Wilson creek drainages in addition to those listed above. Juvenile chinook salmon and suitable chinook salmon spawning areas were observed by Thurow (1985) in ten of the above listed streams except for Wilson Creek. We also included Sheep Creek as a potential spawning stream as a result of its moderate size and the presence of suitable substrate. These 12 tributaries and the mainstem MFSR total about 804 km (Table 1). The remaining tributaries to the MFSR are judged to be too steep or too small to support spawning chinook salmon (Gebhards 1959; K. Ball, IDFG, personal communication).

Returns of adult chinook salmon are influenced by a variety of factors (IDFG 1992) so redd counts will fluctuate annually. As a result of this variation, several years of redd counts will be required to adequately complete this research and it would be useful to follow at least one generation of fish. Spring and summer chinook salmon that spawn in the MFSR have a strong 3-ocean component (IDFG et al. 1990) so one generation would encompass 5 years. We initiated this work in 1995 by counting redds, and completing some aerial versus ground-based redd count comparisons. In 1996 and 1997 we duplicated the 1995 surveys. Post 1997 surveys will again duplicate the earlier methods. For consistency, the principle investigator will conduct all aerial redd counts in the mainstem Middle Fork Salmon River and twelve tributaries.

The primary survey method will be observations from low-level helicopter flights. We will fly all accessible stream reaches after chinook salmon have completed spawning and while redds are visible. Typically chinook have completed spawning by September 5. We will use results of IDFG index area surveys to determine when spawning is completed. Redd locations will be specifically located with the aide of a GPS unit mounted on the helicopter. Some areas of the streams may not be adequately surveyed from a helicopter. Small streams with a large amount of riparian vegetation or shading may be unsuitable for aerial surveys. The observer will record those areas that were judged to be unsuitable for aerial surveys. We will re-survey those areas with ground-based counts.

Objective 2: We defined criteria for potential spawning areas by reviewing existing literature describing spawning of stream-type chinook salmon, observing characteristics of spawning areas currently used in the MFSR, and selecting suitable sites that mimic those characteristics. Chinook salmon select spawning sites with relatively specific substrate sizes, water depths, and water velocities within some minimum-sized area for redd construction (Chapman et al. 1986; Burner 1951). Kondolf (1988) suggested that both substrate framework size and fine sediment content contributed to suitability of gravels for spawning. Our proposed spawning area criteria include: 1.-substrate of predominately gravel (8-64 mm in diameter), with smaller proportions of cobble (>64 mm) and fines. 2.-water depths ranging from 10-90 cm and averaging 30 cm. 3.-water velocities ranging from 0.2-1 m/s and 4.-a minimum areas of 16 m^2 meeting criteria #1-3.

Proposed criteria were based on the following information. Burner (1951) reported that stream-type chinook salmon spawned over substrate comprised of predominately gravel (60-86%), less than 6% of the substrate was sand size or smaller and the remainder was substrate larger than 150 mm in diameter. Thurow and King (INT, personal communication of unpublished data) described the mean surface (0-10 cm) particle size distribution of 15 summer chinook salmon redds in the South Fork Salmon River as 25% of the substrate consisting of cobble (> 64 mm in diameter), 55% gravel (8-64 mm), 10% small gravel (2-8 mm), and 10% sand or finer. Burner (1951) reported depths adjacent to 184 spring chinook salmon redds that ranged from 5-91 cm and averaged 29 cm. King and Thurow (1991) reported depths upstream from 30 completed summer chinook salmon redds that ranged from 12-50 cm and averaged 32 cm. Velocities adjacent to chinook salmon redds have been reported as 0.15-1.07 m/s averaging 0.61 m/s (Burner

1951), 0.37-0.67 m/s (Bovee 1978), and 0.2-0.61 m/s averaging 0.34 m/s (King and Thurow 1991). Redd dimensions provide a estimate of the minimum area of gravel required for a chinook salmon redd. Burner (1951) reported an average area of 3.3 m^2 for 184 spring chinook salmon redds. King and Thurow (1991) reported an average area of 4.7 m^2 for 30 summer chinook salmon redds. Redd dimensions tend to be proportional to the length of spawning fish (Burner 1951, Ottaway et al. 1981, Crisp and Carling 1989) and MFSR chinook salmon are of similar size to those King and Thurow (1991) studied. Burner (1951) reported that the total average area necessary for a pair of chinook salmon to spawn was about four times the average redd area, averaging 16 m^2 for spring chinook. As a result, for redds averaging 4-5 m^2, a minimum area of 16-20 m^2 would be required to support a pair of spawning fish. K. Ball, an IDFG biologist with nearly 20 years of experience counting chinook salmon redds, has observed that chinook salmon rarely build redds in streams less than 3 m wide or in areas where suitable patches are less than 17 m^2.

Both spawning adults and rearing chinook salmon parr appear to be associated with low gradient, meandering C-type (Rosgen 1985) stream channels. Scully et al. (1990) reported that the average density of chinook salmon parr in C channels was 3.5 times the density in B channels. Within watersheds supporting chinook salmon, other researchers observed chinook salmon parr in 50% of the C channel habitats compared to 18% of the B channel habitats and 3% of the A channel habitats (K. Overton and R. Thurow, INT, personal communication of unpublished data). We will attempt to use existing information to map low gradient, C channel reaches in the 12 study streams as indexes to the areas with the highest potential for spawning.

We propose to sample each of the 12 streams listed above and the mainstem MFSR and to map the location of all patches of potential spawning substrate. The primary survey method will be observations from low-level helicopter flights during redd surveys. Potential spawning areas will be specifically located with the aide of a GPS unit mounted on the helicopter. Some areas of the streams may not be adequately surveyed from a helicopter. Small streams with a large amount of riparian vegetation or shading may be unsuitable for aerial surveys. The observer will record those areas that were judged to be unsuitable for aerial surveys. We will attempt to re-survey those areas with ground-based counts. Ground counts will also be conducted in a small number of reaches to validate aerial counts and estimates of potential spawning substrate.

Objective 3: After all potential patches are identified, we will conduct future ground-based surveys to collect empirical information within each patch including measurements of patch length, mean width, and gradient; and characterization of patch quality. We will work with INT watershed scientists to develop a sampling scheme to characterize the substrate, depth, velocity, and gradient of each patch. The search for an index of spawning gravel quality has been a persistent theme in the fisheries literature and Kondolf (1988) argued that no single statistic can adequately describe gravel size distribution. To assess the quality of potential spawning gravel, as we propose, Kondolf (1988) suggested evaluating the substrate framework size and the fine sediment fraction. Framework size and the fines fraction might be evaluated by visual observation methods or by collecting gravel samples via freeze or hollow-core techniques (Platts et al. 1983). The remoteness of the study streams and endangered status of chinook salmon precludes gravel collection. An approach to evaluate framework size would be to use two methods, an ocular estimate of the percent substrate along transects and the Wolman pebble count (Wolman 1954). Within each patch, we would establish random transects and using techniques described by Overton et al. (1995) we would conduct an ocular estimate and a Wolman pebble count along each transect. At randomly selected locations along each transect, we might also use a 20 cm X 20 cm grid to assess surface fines by counting the total number of intersections over sand size or smaller particles (Overton et al. 1995). Patch-specific gradient could be measured using a hand level. Depths and velocities within patches might be measured with a flow meter and rod, either at randomly selected locations or along transects.

We will calculate patch area and use that variable to represent patch size. Patch location or context will be represented by either the distance to the nearest patch supporting redds or by a value calculated from the number of redds within a predetermined distance of a patch (number of redds within 20 km, for example). Patch quality will be represented by a single variable of gravel quality or a variable derived from substrate, depth, velocity, and gradient measurements at each patch.

Objective 4: Existing databases describing geomorphic landscape features (parent geology, elevation, aspect, etc.) will be acquired. We will attempt to predict the presence of patches and perhaps patch quality using the suit of landscape features described above and in cooperation with RMRS watershed scientists. The dependent variable will be presence/absence of patches or patch quality and the independent variables will represent landscape variables. An expected equation would be: Presence/absence of patches= F(Landscape Features). We will conduct an initial analysis to determine which independent variables are correlated. Finally, we will evaluate and apply the most appropriate analysis technique to determine which variables have the largest predictive power.

Objective 5: To draw inferences about spatial processes influencing local populations, potential habitat patches should be consistent in scale with the habitat defining local populations (Rieman and McIntyre 1995). We propose to define patches for chinook salmon as discrete and contiguous areas of stream substrate judged to be suitable for spawning. Patches will be required to meet four criteria: 1.-accessible to chinook salmon, 2.-discrete areas separated by some distance of unsuitable spawning habitat from other patches. We will analyze the data to verify the best estimate of distance between patches. 3.-high potential to have reproductively isolated spawning groups, and 4.-must meet criteria for minimum patch size, gradient, substrate size, water depth, and water velocity judged to be suitable for chinook salmon spawning.

Chinook salmon are known to display strong site fidelity and home to natal areas. Homing is apparently linked to olfactory imprinting that may return fish to specific stream reaches (Quinn 1993). Rieman and McIntyre (1995) suggested that, as a result of homing, fish originating from a particular patch have a higher probability of mating with fish from that patch than with fish from another patch. We will evaluate the data to determine how much distance between patches is necessary to isolate spawning groups.

We will conduct our analysis of the influence of patch size, location, and quality at both the stream (N = 12) and basin (all streams pooled) scale. We will attempt to predict the presence of chinook salmon redds using patch size, location (context), and quality. The dependent variable will be presence/absence of redds and the independent variables will represent patch size, location, and quality. An expected equation would be: Presence/absence of chinook salmon redds= F(Patch Size) + F(Patch Location) + F(Patch Quality). We will evaluate and apply the most appropriate analysis technique after considering logistic regression (Rieman and McIntyre 1995), multiple linear regression, and discriminant function analysis.

f. Facilities and equipment.

This research necessitates rental of helicopter and fixed-wing aircraft for aerial surveys and to obtain remote access for ground-based surveys. In some cases, motor vehicle may also be used for access during ground-based surveys. The researchers will provide the necessary GPS equipment and software, GIS equipment and software, and office space. Major equipment purchases will include float gear for mainstem river access and backpack equipment for use during ground-based surveys.

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Section 8. Relationships to other projects

This research fully complements the annual chinook salmon redd surveys completed by a large group of collaborators including the Idaho Department of Fish and Game, the Nez Perce Tribe, the Shoshone-Bannock Tribe, and National Forests including the Payette, Boise, Salmon-Challis, and Sawtooth. Although the research will require multiple years to follow one or more generations of chinook salmon, results to date have proven very useful to researchers, biologists, and managers from a variety of agencies and tribes. Prior to this project, chinook salmon were inventoried in Aindex≅ areas only. This research represents the first comprehensive survey of spawning areas and redds in the basin and provides key information on overall spawning escapements and the distribution of fish. Results of annual surveys have been disseminated to a variety of federal and state agencies, universities, and tribes. In 1997, the principle investigator began collaborating with a University of Idaho project designed to assess passage of adult chinook salmon at dams and their movement into tributaries. During aerial redd surveys, we assisted the University of Idaho researchers by radio tracking tagged chinook salmon in the areas we flew.

Section 9. Key personnel

Russell F. Thurow is the Principal Investigator and serves as a Research Fishery Biologist for the Rocky Mountain Research Station in Boise, Idaho. He serves as a member of a team of scientists investigating fish population dynamics, habitat relationships, and factors influencing persistence. The mission of the team is to provide new information and techniques for understanding, conserving, and restoring fish populations and critical habitats in the Intermountain West. Three months of his time are charged to the proposal budget. He will direct the project, complete the annual redd surveys for consistency, aerially map potential spawning patches, coordinate the ground-based surveys, and work with other scientists (including RMRS team members Bruce E. Rieman and Danny C. Lee, see below) to complete data analysis, interpretation, and transfer of the information. The scientist is responsible for a comprehensive research program focused on the biology of sensitive species. He conducts a series of individual studies that are conceptually related to the complex problem of conservation and restoration of sensitive native fishes. The scientist is currently working in three identified broad research problems areas: (1) identifying and understanding processes that influence the temporal and spatial distribution of critical habitats for sensitive native salmonids and other aquatic vertebrates; (2) developing techniques for understanding demographic and environmental threats to persistence of fish and aquatic vertebrates; and (3) developing interdisciplinary decision support tools that assist managers in conserving and restoring critical habitats and viable fish populations. He has extensive experience with anadromous salmonids and with the techniques employed in this research. He has already completed annual redd surveys in 1995, 1996, and 1997 and has mapped potential spawning patches in several tributaries. He is intimately familiar with the study area and maintains good working relationships with collaborators from agencies, tribes, and universities. Degrees: M.S. Fisheries Resources, University of Idaho 1976; B.S. Fisheries, University of Wisconsin-Stevens Point 1973. AFS Certified Fisheries Scientist 1985. Recent employment: Fisheries Research Biologist, Idaho Department of Fish and Game, 1977-1990. Recent relevant publications: 1) Thurow, R. 1985. Middle Fork Salmon River fisheries investigations. Job Completion Report. Federal Aid in Fish Restoration Project F-73-R-6. Idaho Department of Fish and Game, Boise. 100 pp. 2) Thurow, R.F. and J.G. King. 1994. Attributes of Yellowstone cutthroat trout redds in a tributary of the Snake River, Idaho. Transactions of the American Fisheries Society 123:37-50. 3) Magee, J.P., T.E. McMahon, and R.F. Thurow. 1996. Spatial variation in spawning habitat of cutthroat trout in a sediment-rich basin. Transactions of the American Fisheries Society 125:768-779. 4) Lee, D.C., J.R. Sedell, B.E. Rieman, R. F. Thurow, and J.E. Williams. 1997. Broadscale assessment of aquatic species and habitats. An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins. Volume 3, chapter 4. U.S. Forest Service General Technical Report PNW-GTR-405. 5) Thurow, R.F., D.C. Lee, and B.E. Rieman. (In Press). Status of chinook salmon and steelhead in the interior Columbia River basin and portions of the Klamath River basin. Pages 00-00 in E.E. Knudsen, C.S. Steward, D.D. MacDonald, J.E. Williams, and D.W. Reiser, editors. Sustainable Fisheries Management: balancing conservation and use of Pacific salmon. Ann Arbor Press, Ann Arbor, Michigan.

Bruce E. Rieman is a cooperating scientist on the project with one month of budgeted time. He has extensive experience in the biology, dynamics, and conservation of fishes in the Intermountain Region and has been particularly active in testing the application of metapopulation theory to salmonids. Degrees: PHD Fisheries; M.S. Fisheries Resources; B.S. Zoology, University of Idaho.

Danny C. Lee is a cooperating scientist on the project with one month of budgeted time. He has extensive experience in ecological modeling, biometry and applied statistics, and conservation biology. Degrees: PHD Wildlife and Fisheries Science, Texas A&M; Masters Applied Statistics, Louisiana State University; M.S. Ecology, University of Tennessee; and B.S. Zoology, University of Tennessee.

Section 10. Information/technology transfer

Studies will result in publishable contributions to the fields of fish biology and management, ecology, population biology, and conservation biology. Information will be distributed via contract reports; peer-reviewed publications in professional journals; oral papers presented at professional meetings, technical conferences, and workshops; in response to information requests; and at informal meetings with state and federal agencies, tribes, and university scientists involved in management of Snake River chinook salmon.